

"APPROVED"

Head of the department of Steel and Timber Structures

 / Sergiy Bilyk /

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Developer

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Syllabus

Inspection and strengthening of building structures: Steel and Timber Structures

1) Code according to the educational program: OK8
2) Academic year: 2023/2024
3) Educational level: master's degree
4) Form of education: full-time, extramural
5) Field of knowledge: 19 ARCHITECTURE AND CONSTRUCTION
6) Specialty, name of the educational program: 192 Construction and civil engineering "Industrial and civil construction"
8) Status of the educational component: basic
9) Semester: 1
11) Contact details of the teacher: Viacheslav Adamenko, Ph.D., Associate Professor link to teacher profile https://www.knuba.edu.ua/faculties/bf/kafedri-bf/katedra_mdk/vikladackij-ta-dopomizhnij-sklad-katedri-mdk/adamenko_v_m/ e-mail: adamenko_vm@knuba.edu.ua
12) Language of teaching: English
13) Prerequisites (precursor disciplines that must be studied in order to take this course): Bachelor's degree courses of the same specialty: Construction and Civil Engineering.
14) Purpose of the course: Provide students with competence and learning outcomes in the inspecting of steel and timber structures, evaluating and reporting of structural conditions, quality control provisions, control of material properties, structural design, connections, and welding, visual inspecting, destructive and non-destructive testing, load testing. Provisions for the strengthening of existing steel and timber structures, including requirements for the use of new materials and methods, the addition of new members, the use of overlays or coatings, and the application of new connections, information on a variety of strengthening techniques, according to Eurocodes and United States codes.

15) Learning outcomes:						
No	Learning outcome			A method of testing the educational effect	The form of classes	Reference competence
1.	LO1. Demonstrate the ability to analyses information in the field of professional activity. Be able to identify problems and, based on the knowledge gained, formulate ways to solve them. Make reports on the implementation of work. Critically evaluate work results and identify ways to improve results.			Intermediate and final control (exam, protection of course work)	Lectures and practical classes. Student's independent work	IC GC1, GC2, GC5, GC8, GC10, PC1, PC2, PC4, PC5
2.	LO2. Demonstrate the ability to act as an individual taking responsibility for a decision and work in a team. Manage a team when working on complex projects, including in an international format.			Intermediate and final control (exam, protection of course work)	Lectures and practical classes. Student's independent work	IC GC1, GC3, GC6, GC7, GC8, GC10, PC1, PC2
3.	LO3. Demonstrate the ability to understand general professional and professionally oriented regulatory documents, technical and scientific publications and use them in their activities to solve non-standard problems.			Intermediate and final control (exam, protection of course work)	Lectures and practical classes. Student's independent work	IC GC1, GC2, GC6, GC10, PC1, PC2, PC5
4.	LO 4. Demonstrate the ability to work with technical documentation and modern software tools and technologies for design and construction to solve complex engineering and technical problems in the implementation of complex projects.			Intermediate and final control (exam, protection of course work)	Lectures and practical classes. Student's independent work	IC GC1, GC2, GC6, GC10, PC1, PC2, PC3, PC5
7.	LO7. Demonstrate the ability to design structures of buildings and structures of varying architectural and technical complexity, using modern multidimensional modelling systems. Provide reliable and economically feasible design solutions.			Intermediate and final control (exam, protection of course work)	Lectures and practical classes. Student's independent work	IC GC1, GC2, GC8, GC10, PC2, PC3, PC4, PC5
8.	LO 8. Demonstrate the ability to operate, inspect and determine the technical condition of buildings and structures.			Intermediate and final control (exam, protection of course work)	Lectures and practical classes. Student's independent work	IC GC1, GC2, GC6, PC1, PC2, PC5
9.	LO 9. Demonstrate the ability to design and carry out the reconstruction of buildings and structures for industrial and civil purposes using prefabricated and monolithic reinforced concrete, steel, stone structures and composite materials.			Intermediate and final control (exam, protection of course work)	Lectures and practical classes. Student's independent work	IC GC1, GC2, GC5, GC6, GC10, GC11, PC1, PC2
16) Course structure						
lectures, hours		Practical training, hours	laboratory classes, hours	Course project/ course work/ term paper /Control work	Student's independent work, hours	Form of final control
full-time	20	12	-	Course work	58	credit
extramural	10	6	-	Course work	74	credit
Total hours:				90		
The total number of ECTS credits				3,0		
Number of hours (ECTS credits) of classroom workload:				32 hours - full-time 16 hours - extramural		

17) Course content: (separately for each form of classes – L/P/Lab/ KR/SRS)

Module 1. Steel and Timber Structures.

Lecture classes:

Content module 1. Inspection of Steel and Timber Structures

Topic 1. (2 h.) Codes for the inspection of steel and timber structures. Codes for strengthening of steel and timber structures.

Eurocode 0: Basis of Design (guidance on the design and inspection of steel and timber structures, as well as requirements for the assessment of structural safety and reliability), Eurocode 3: Design of Steel Structures (inspection and maintenance provisions), Eurocode 5: Design of Timber Structures (inspection and maintenance provisions), Eurocode 2: Design of Concrete Structures (inspection of timber-reinforced concrete structures), Eurocode 8: Design of Structures for Earthquake Resistance (inspection and maintenance provisions for earthquake-resistant structures), American Society of Civil Engineers (ASCE) 7, American Society of Civil Engineers (ASCE) Standard 10-15, American Institute of Steel Construction (AISC) Standard 360, American Welding Society (AWS) D1.8/D1.8M, National Design Specification for Wood Construction (NDS), American Wood Council's Timber Construction Manual (TCM), National Fire Protection Association (NFPA) 5000, International Building Code (IBC).

Topic 2. (2 h.) General assessment procedure, four separated phases. Preliminary evaluation, Detailed investigation, Expert investigation, Remedial measures.

Preliminary evaluation. The aim is to remove existing doubts about safety of the structure using fairly simple methods and identify critical parts or members in the structure. This is performed by gathering information on the structure from drawings and design computations, carrying out a site visit, etc. The assessment should be carried out by the engineer alone.

Detailed investigation. The aim is to update information and to carry out refined assessments only for those members where safety is not ensured. Here, in addition to the engineer, a specialised firm or agency or individual experts are generally called in.

Expert investigation. For problems with large consequences in terms of risks or of costs related to a decision, a team of experts should be called in order to check carefully the conclusions and proposals reached in Detailed investigation.

Remedial measures. The aim is to propose measures to have a fit for service structure with sufficient safety. Different measures can be taken, among them one can mention: intensification of monitoring, reduction of loads or change in use, strengthening, repair or rehabilitation.

Topic 3. (2 h.) Inspection, evaluation, and reporting of structural conditions. Inspection of steel and timber structures. Visual inspection. Visual inspection report.

Examining the surface of the steel for any signs of damage, such as cracks, corrosion, or deformation. Checking for any signs of distortion or misalignment of structural members, such as beams or columns, welds and connections.

Examining the surface of the timber for any signs of damage, such as cracks, splits, or decay. Checking for any signs of deformation or twisting of the structural members, any signs of insect or fungal damage, connections and joints. In addition to visual inspection, the use of a moisture meter may also be used to detect any moisture content in the timber, which can indicate potential issues with decay or rot.

Identifying any areas of concern that require further investigation.

Topic 4. (2 h.) Structural Steel tensile destructive and non-destructive testing. Steel hardness testing. Steel tensile testing (universal testing machine). Steel creep testing. Ultrasonic thickness gauging. Load testing of steel and timber structures.

Topic 5. (2 h.) Testing of Welding. Destructive testing methods: tensile testing, bend testing, and impact testing (mechanical properties of the welded joint, such as its strength and ductility).

Non-destructive testing methods: visual inspection, liquid penetrant testing (dye penetrant testing (DPT)), magnetic particle testing, ultrasonic testing, and radiographic testing (surface cracks, internal voids, and other defects without damaging the welded joint).

Content module 2. Strengthening of Steel and Timber Structures

Topic 6. (2 h.) Causes and analysis of steel and timber structural failures. Errors in the design of structures (errors in the project, incorrect determination of loading, inappropriate structural solutions), defective or inadequate material, defects during fabrication and erection, failures caused by operations. Results of defect analysis.

Topic 7. (2 h.) Basic methods of strengthening of steel and timber structures. Strengthening of elements by enlargement of the original cross section (strengthening of angled girder cross-sections, strengthening of member cross-sections in lattice structures, strengthening of column cross-sections and struts). Strengthening of joints and connections.

Topic 8. (2 h.) Strengthening by changes to the static system (insertion of additional stiffeners and members into the original structure, change of the static system). Strengthening by additional prestress (strengthening using prestressing

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draw bars, strengthening by forced deformation). Strengthening of steel elements by coupling with concrete. Strengthening of elements under loading (elements stressed by bending, techniques for reinforcing elements under loading).

Topic 9. (2 h.) Repair and reconstruction of industrial and civil structures. Practical cases.

Topic 10. (2 h.) Repair and reconstruction of engineering structures. Practical cases.

Module 2. Structural Strengthening of Steel Frame Building

Strengthening Steel Frame Building Using Structural Engineering Software (Course work).

Practical classes:

Practical class 1. Types of structural engineering software. Robot Structural Analysis Professional and Tekla Structural Designer.

Practical class 2. Structural Assessment of Existing Steel Frame Building: conducting a thorough assessment of the existing steel frame building structure. Collecting data such as the building plans, as-built drawings, structural drawings, and any available inspection reports. Preparing the data to be imported into the structural engineering software.

Practical class 3. Modeling the Steel Frame Building Structure: Creating a detailed 3D model of the building structure using the structural engineering software. Creating a new project, defining the units, material properties, and other project settings. Defining the building geometry.

Practical class 4. Analyzing the Steel Frame Building Structure: using the structural engineering software. Determining the building's load-carrying capacity and identifying any areas of weakness that require strengthening.

Practical class 5. Designing Strengthening Measures: using the software to design strengthening measures. Selecting the appropriate materials and methods for strengthening, such as adding additional steel members, strengthening existing members, or adding braces or supports.

Practical class 6. Simulating the Strengthening Measures: simulating how the building will respond to various loads and forces. Testing the effectiveness of the proposed measures and making any necessary adjustments.

Course work on the topic:

«Strengthening Steel Frame Building Using Structural Engineering Software».

Composition of the course work:

Calculation and explanatory note (up to 30 pages of handwritten or printed text):

1. Results of Structural Assessment of Existing Steel Frame Building.
2. Results of Modeling the Steel Frame Building Structure.
3. Results of Analyzing the Steel Frame Building Structure.
4. Results of Designing Strengthening Measures.
5. Results of Simulating the Strengthening Measures.

Graphic part of the work. 3 sheets of drawings in A3 format.

18) Basic literature:

Textbooks:

1. Metalevi konstruktsii: Pidruchnyk dlia studentiv vyshchykh navchalnykh zakladiv / Nilov O.O., Permiakov V.O., Shymanovskiy L.V., Bilyk S.I., Lavrinenko L.I., Bielov I.D., Volodymyrskyi V.O. – Vydannia 2-e. - K.: Stal, 2010. – 869 s.

19) Additional sources:

1. EN 1990 (2002) (English): Eurocode – Basis of structural design [Authority: The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC]
2. EN 1991-1-1 (2002) (English): Eurocode 1: Actions on structures – Part 1-1: General actions - Densities, self-weight, imposed loads for buildings [Authority: The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC]
3. EN 1991-1-3 (2003) (English): Eurocode 1: Actions on structures - Part 1-3: General actions - Snow loads [Authority: The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC]
4. EN 1991-1-4 (2005) (English): Eurocode 1: Actions on structures - Part 1-4: General actions - Wind actions [Authority: The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC]
5. EN 1993-1-1 (2005) (English): Eurocode 3: Design of steel structures - Part 1-1: General rules and rules for buildings [Authority: The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC]
6. EN 1995-1-1 (2004) (English): Eurocode 5: Design of timber structures - Part 1-1: General - Common rules and rules for buildings [Authority: The European Union Per Regulation 305/2011, Directive 98/34/EC, Directive 2004/18/EC]

20) Educational achievement evaluation system (distribution of points):			
Current assessment		Final control (control work)	Sum
content module 1	content module 2		
30	30	40	100
<p>21) Conditions for admission to the final control:</p> <p>The condition for admission to the credit is to defend the course work and attend lectures. For a good reason (illness or other force majeure circumstances), attendance at lectures may be replaced by an essay on the topic of the lecture to take into account points in the final control (Or can be replaced by listening to the course on the MS platform Teams and independent processing of the course outline).</p> <p>An applicant who has not fulfilled the requirements of the work program is not allowed to take the final control. An applicant who has a final grade for the educational component (after completing all types of work) from 35 to 59 points is assigned an additional test session. In this case, he/she must complete all types of work in accordance with the established requirements for the content of the relevant content modules in the period between the main and additional sessions.</p> <p>The applicant has the right to protest the results of the control (appeal). The rules for filing and considering an appeal are determined by the internal documents of KNUCA, which are posted on the KNUCA website and the content of which is communicated to applicants before starting the discipline.</p>			
<p>22) Academic Integrity Policy:</p> <p>It is carried out at the university in accordance with the REGULATIONS on measures to support academic integrity at the Kyiv National University of Construction and Architecture (valid in accordance with the order of the rector No. 180 of April 21, 2020).</p> <p>The results of students' learning on the principles of academic integrity and academic writing are the ability to: act in professional and educational situations from the standpoint of academic integrity and professional ethics; independently perform academic tasks; correctly refer to sources of information when borrowing ideas, statements, information.</p> <p>Copying during testing and other written surveys is prohibited (including using mobile devices). In the case of discovery of facts of write-off by the acquirer, he receives another task. In case of repeated detection, an additional class is assigned for testing.</p>			
<p>23) Link to the page of the electronic educational and methodological complex of the discipline:</p> <p>https://org2.knuba.edu.ua/course/view.php?id=2294</p>			